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Contents

List of Tables

List of Figures

1. Introduction

1.1 Introduction on Military Conscription

Most economists favor an all-volunteer armed force to a conscripted one, based on the economic theory of comparative advantages. Many empirical studies in this field focus on the static efficiencies in terms of lifetime earnings associated with military conscription. For aggregate effects, Keller et al. (2009) show empirically that conscription has negative effects on both income levels and economic growth in OECD countries. The trend of abolishment of conscription in OECD countries, which started in the 1990s after the end of the Cold War, provides an opportunity to examine the debate between a conscripted and an all-volunteer armed force. According to theory, the conscription system ignores the comparative advantage of people who have to do the compulsory service, and may therefore distort the accumulation of their human and physical capital, which then depresses output and growth (Lau et al, 2004).

This thesis is largely inspired by the empirical work of Keller et al. (2009). I extend their sample to 2010, and include three additional relevant variables. First, is the conflict dummy variable, hoping to control for additional military determinants. Second, is the ratio of conscripts to the total armed force personnel, which is intended to capture some of the effects of the abolishment of conscription, and to examine whether the reduction in conscripts in the composition of the total armed force personnel has positive effects on economic performance as theory predicts. Third, is the ratio of armed force personnel to the labor force, included to examine the relationship between the size of the armed force personnel and economic performance. Furthermore, instead of running cross-country and panel regressions with averages from decades as in Keller et al., I run my panel regressions by year to obtain hopefully better estimates.

The estimates obtained in the thesis are not always in line with what the theory predicts. For example, the share of conscripts in the armed personnel is only estimated to have negative effects on GDP per unit of the labor force when inflation and fixed effects are not accounted for (A 10% increase in this share variable decreases GDP per labor force by 0.098%, holding all else constant.) As for its effect on economic growth, measured by the GDP per capita growth rate, it also only has negative and significant effects when not controlling for inflation and fixed effects. Without further specifications, a 10% increase in the share of conscripts to

the armed force reduces GDP per capita growth rate by 0.0595%, ceteris paribus. When country and year fixed effects are added, the coefficient estimates of this variable on income and growth become positive and significant.

When fixed effects are added, all conscription variables have a surprisingly mostly positive effect on both income levels and growth rates, which cannot be explained solely by the mainstream theory. The results imply that the negative effect of conscription on economic performance is not robust to fixed effects.

The rest of the thesis is organized as follows: the next section reports further background information on military conscription, followed by the literature review on conscription in section two, which tends to be divided into three types of costs: static, dynamic, and other economic costs. The section after describes the model and data used for estimation, which is an augmented Solow growth model, following the tradition of Keller et al (2009). The fourth section presents the results, which are surprisingly somewhat different than the findings of Keller et al (2009). I also provide interpretations of these results. Sensitivity tests are also reported in this section. The fifth section concludes.

1.2 Further Background

What is military conscription?

Military conscription, or the military draft has been the main source of armed force personnel recruitment for most countries throughout history. Almost all countries in the world have military manpower (except Iceland). Instead of military conscription, a government can also rely on an all-volunteer force, or a combination of both compulsory and voluntary recruitment systems.

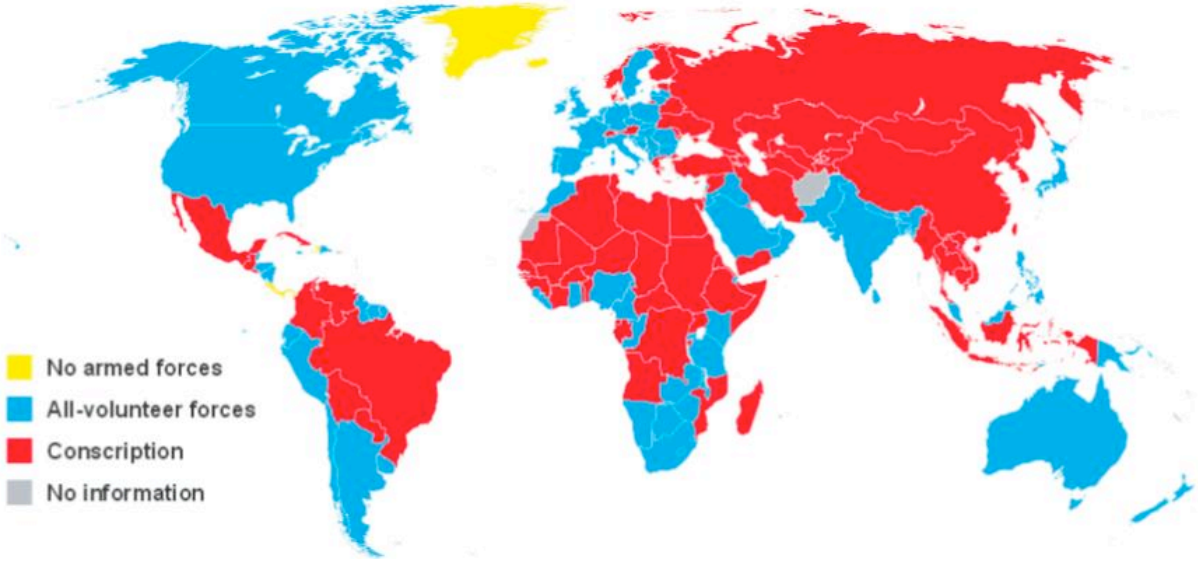
Throughout time, conscripted soldiers have been the dominant source of military manpower. Both World Wars were fought with conscripts. For the government, the conscription system is cheaper to finance than an all-volunteer force. The choice between the two systems is likely to depend on the government's ability to tax, either by levying an in-kind tax on conscripts, or monetary tax to hire and keep professional soldiers.

Both the volume and duration of conscription are sizable. Almost all young male citizens who are deemed to be able-bodied are subject to conscription (Israel being a special case of recruiting also female conscripts), and the length of compulsory military service was by and large over 1.5 years in the past. Given the compulsory nature of conscription, its volume and duration, it is of interest for economists to find out whether and to what extent conscription has an influence on economic performance.

Some recent development in the military sector:

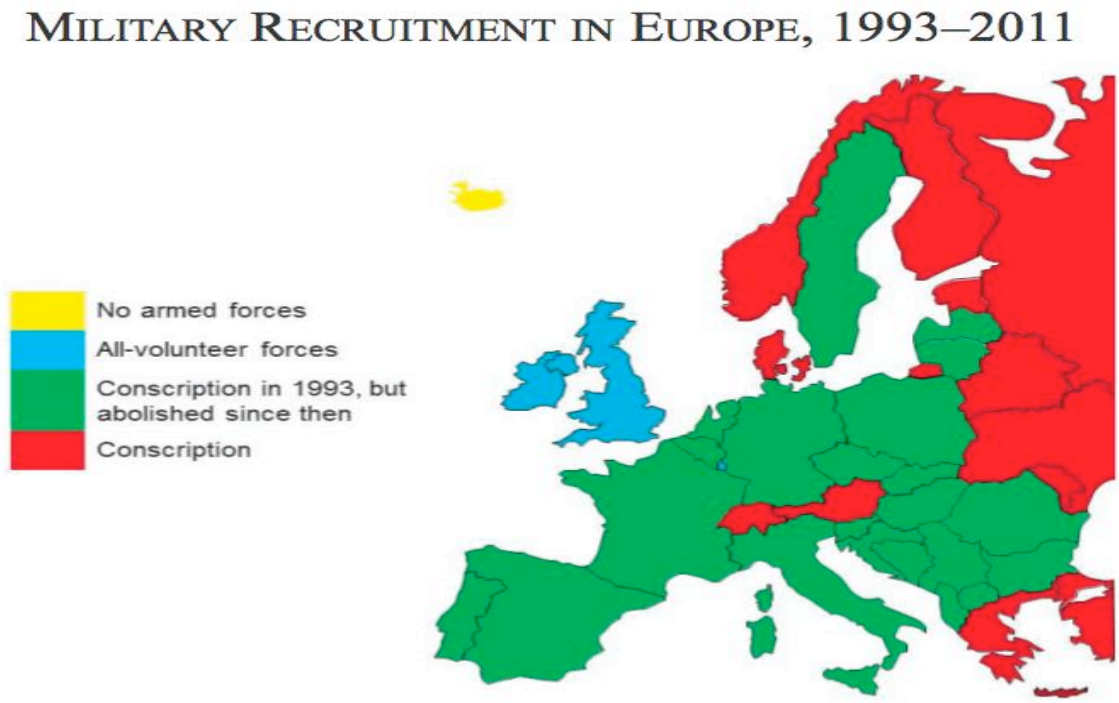
While the tradition of keeping a conscripted armed force remains in most parts of the world (countries marked in red in Figure 1 below), and for most OECD countries until the mid 1990s, there have been significant developments in the functioning of the military in the recent past. The progress in developing modern weaponry, information technology such as the advent of the internet, the fall of communism, and military adventurism, etc., all make the military sector less labor-intensive and require more professional skills. This trend towards more specialized armed force personnel can be seen in OECD countries. The United Kingdom abolished conscription in 1960, followed by Luxembourg in 1967, and the United States in 1973. In 1985, just eight out of 22 OECD countries that had a population over one million still used conscription. After the end of the Cold War, most western European countries started to abolish or phase out conscription, as Figure 2 shows. In Figure 3, one can see the trend towards abolishment of conscription in a sample of 21 OECD countries[1]. Each dot in Figure 3 represents the (unweighted) average percentage of conscripts in total armed personnel in these 21 OECD countries. Since 1990, and the end of the Cold War, there is a constant decrease in the ratio of conscripts to total armed personnel.

Figure 1: Military Recruitment Around The World, 2011



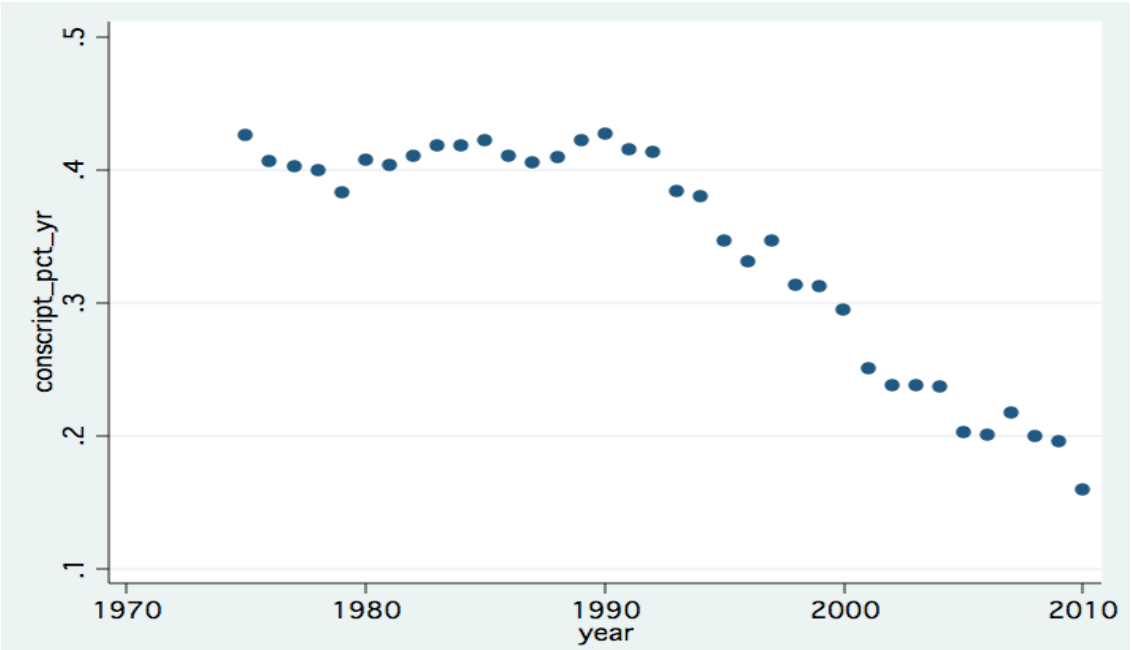
Source: Wagener and Poutvaara, Ending Military Conscription, 2011

Figure 2: Military Recruitment in Europe



Source: Wagener and Poutvaara, EndinngMilitary Conscription, 2011

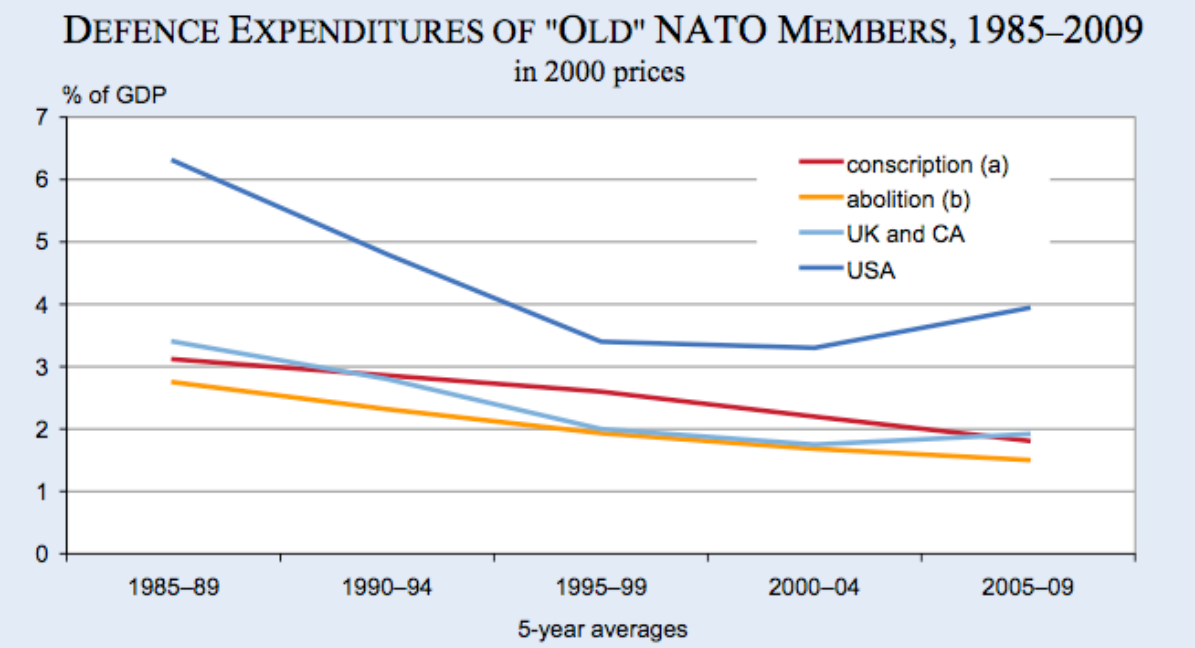
Figure 3: Unweighted Ratio of Conscripts to Total Armed Force Personnel



[1] These are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States of America. Source: own calculations

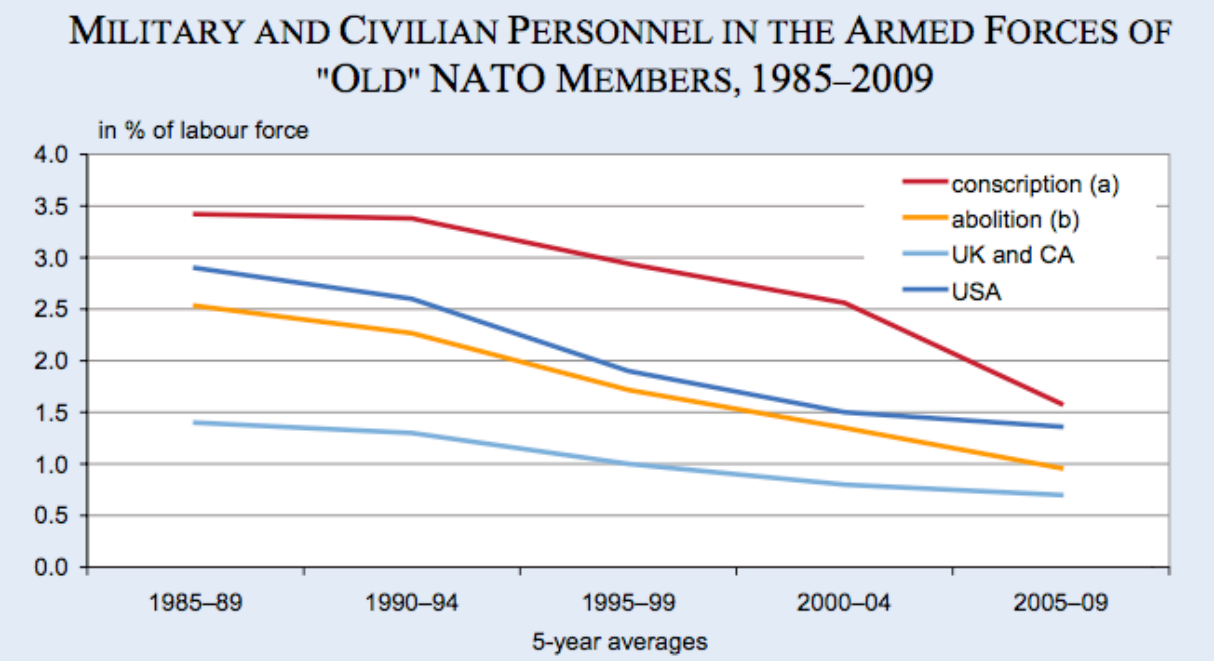
From Poutaara and Wagener's (2011) research finding, one can see in Figure 4 below that aside for different starting levels, military expenditures from 1985 to 2009 do not vary much for conscription countries (Denmark, Germany, Greece, Norway, and Turkey) and countries that abolished conscription (Belgium, France, Italy, the Netherlands, Portugal, and Spain) in early 1990s. There seems to be no clear correlation between use of conscription and military expenditure. However, countries that still use conscription seem to afford larger military budgets. Figure 5 shows quite unsurprisingly, that conscription countries have the highest percentage of armed personnel in the labor force. The reduction in armed personnel in the total labor force is to be seen for all country groups from 2000, and the reduction is largest for the conscription country group. This might indicate the problem of unfair selection in conscription system, and/or that more young people who are subject to conscription were willing and able to serve in alternative service. Surprisingly, the abolishment of conscription does not seem to reduce military budgets nor army size in relative terms.

Figure 4: Defense Expenditure of 'Old' Nato Members



Source: Wagener and Poutvaara, Ending Military Conscription, 2011

Figure 5- Military and Civilian Personnel In The Armed Forces of 'Old' Nato Members



Source: Wagener and Poutvaara, Ending Military Conscription, 2011

Conscription and alternative service:

The quality difference between conscripted soldiers and professional soldiers is expected to be significant. Conscripted soldiers have shorter periods of training, less on-the-field experience, and high turnover rates. Moreover, conscripts are paid less than same-rank professionals, and do not enjoy the same perks for veterans and (retired) professionals, who might enjoy a higher interest rate in saving, better health insurance, discounts on grocery, etc. Since most conscripts do not seek a professional soldier career after their forced service time, it should be assumed that their military productivity is lower due to lack of skills, experience, incentives and motivation. There is unfortunately very little data on whether conscripts were actually sent to fields of real wars, except in the case of Australia and the United States of America during the first years of the Vietnam War

As a corollary to conscription, most democratic countries offer alternative service to conscientious objectors. Unfortunately, there is not enough data on the volume and duration of alternative service for a cross-country empirical analysis. One should bear in mind that alternative service has economic costs too, such as setting up screening-commission panels, and other bureaucratic burdens. The length of alternative service is usually longer than that for military service. From the little data available, Denmark is the only country that has the

same length of service, 4 months, for both alternative and compulsory military service. Austria has a longer length of alternative service, which is systematically 50% longer than normal military service. (8 months for Zivildienst, or alternative service as in 2011), Greece is also punitive in alternative service length, 15 months as in 2011 which is about two-thrids longer than normal military service time. Most punitive is Finland, which has a 100% longer spell in alternative service (12 months) than in military service (6 months). People in alternative service usually work in civilian and social sectors, and some argue that it provides valuable social benefits at lower budgetary costs.

Conscription and Efficiency Loss:

The main arguments against conscription are focused on the mismatch in comparative advantages. Adam Smith (1976 [1776]: 701) provides a clear intuition against conscription and found an 'irresistible superiority which a well-regulated standing army has over a militia'. In other words he preferred a professional armed force to conscription. A conscription system ignores the differences in comparative advantages and productivity, and assigns all conscripts to similar tasks for the same output. This mismatch is inefficient and adds further opportunity costs, and should lead to output loss compared to an all-volunteer armed force. From conscripts' point of view, the opportunity cost of serving in the army is likely to be larger than their willingness-to-pay to avoid the draft. The missed opportunity can be, for example, postponed/disturbed continuation of education, training, on the job experience and earnings. Switzerland is the only country in the world that actually accepts monetary payments in order not to serve in conscription (the exemption fee is 3% of annual income tax until the age of 30).

Few economists are in favor of conscription, but their arguments are also centered around comparative advantage. Lee and McKenzie (1992) and Warner and Ash (1995) argue that conscription can be socially more costly than professional army if the latter's budgetary costs are financed through high and distortionary taxes. Most other economists, such as Hansen and Weisbrod (1967), Oi (1967), Fisher (1969), Poutvaara and Wagener (2005), do see potential in efficiency loss in conscription due to the mismatch in comparative advantages and productivity. The efficiency loss ranges from static dead-weight loss to long-term distortions in output. The same logic of efficiency loss also applies to alternative service given its compulsory nature.

In terms of the effects of conscription on real output, Hansen and Weisbrod (1967) provide estimates of monetary cost of conscripted soldiers to the United States. Some other

static costs estimates for other countries are reported in the literature review, in the section 2.2.1. For the dynamic, long term effects, Lau et al (2004) provide computational equilibrium simulations, which show that the long-term GDP can be depressed by up to 1%, if the whole population is subject to conscription (or to any similar form of compulsory service).

The work of Keller, Poutvaara, and Wagener (2009) is the first large-scale empirical work testing the hypothesis that in the long run, military conscription hampers economic performance. They examine 21 OECD countries (same country sample as in Figure 3) from 1960-2000 and find negative and significant effects of conscription on both income levels and growth. So far it is the only work that empirically studies the long-run effects of military conscription on economic performance at the macroeconomic level.

This thesis extends the work of Keller et al. to 2010, uses panel data by year, and adds few new variables. The results are surprisingly quite different. Most important finding is probably that the expected negative effects of conscription seem not to exist, when fixed effects are being controlled for.

2. Literature Review

2.1 Theoretical Studies

The choice between a professional and a conscripted army was debated in the 18th century by Adam Smith and Immanuel Kant. Kant states in the third preliminary article of Perpetual Peace (1795) that "Standing armies (miles perpetuus) shall in time be totally abolished" because they are themselves "a cause of offensive war." In other words, Kant argues that a perpetual standing army (mercenary soldiers) is the source of potential conflicts. Of course there is a difference between Kant's 'standing armies' and the modern professional, voluntary soldiers. Kant's standing armies might have referred to foreign mercenary soldiers during the medieval periods, or for example, the German Hessians hired by the British to fight the rebellious American colonists during the War of Independence. Curtis (1982) points out this important difference in the definition: 'Mercenary soldiers hired for service in an army not of their own country are not the same as a modern, volunteer army—that is, one in which citizens choose to serve in their country's armed forces.' James and Choi (2003) provide empirical results that contradict Kant's view on military manpower system: for the period from 1886 to 1992, they show that conscripted soldiers are significantly connected to more militarized interstate disputes than professional soldiers.

Adam Smith shows his preference for professional soldiers over conscripts in terms of economic interest. He finds 'irresistible superiority which a well-regulated standing army (professional soldiers) has over a militia (conscripts)' (1776). The main arguments against conscription from Smith and most other economists are focused on the comparative advantage and benefits from specialization. People have different skills and are good at different tasks, this implies that not everyone is a good soldier. The skills, experience and expertise (in handling complex weaponry, for example) required for a good soldier are harder for conscripts to achieve given their shorter periods of service, high turnover rates, and perhaps most importantly, lack of motivation. Therefore, the labor productivity of conscripts should be lower than professional soldiers. A society that relies on conscription would have to forgo the productivity gains from a professionalized army in terms of military output (perhaps in the form of 'peace-dividend' from crisis-averting and peace-keeping functions, as argued by Knight et al. 1996), and bear the opportunity costs from the mismatch of comparative advantages among conscripts. Poutvaara and Wagener (2007) provide interesting analogy of

this mismatch, 'Forcing everybody to serve in the military is no more sensible than forcing all citizens to work as nurses, heart surgeons, or teachers.'

Little had been said on this debate since the comments of these two individuals until the escalation of the Vietnam War in 1966. Over the next five years, together with public debates, economists produced a substantial volume of research on the feasibility and efficiency of an all-volunteer armed force. Major contributors include Walter Y. Oi (1967), Hansen and Weisbrod (1967), Altman and Fechter (1967), Friedman (1967), Fisher (1969), and Altman and Barro (1971). With Friedman on the board of the Gates Commission, which was established by Richard Nixon, conscription was abolished in the United States in 1970 following a unanimous recommendation of the board members.

Among academics who are not in favor of conscription Hansen and Weisbrod (1967), Warner and Ash (2001), Poutvaara and Wagener (2007), and Pfaffenzeller (2009) recognize and summarize the distributive and allocative effects of conscription on real gross national product. Given the compulsive nature of conscription, there has to be some sort of selection procedure (at least for the United States), that creates uncertainty for 'draftable' young men and their employers, and a possible selection bias which can be an issue of fairness. The apparent cheapness of draftee labor means a below market wage, and would imply more enlistment than necessary, leading to an excessive personnel-capital ratio in conscript armies. Furthermore, the opportunity costs for the conscripts exceed the fiscal costs by the maximum amount draftees are willing to pay to avoid compulsory service. These costs can be measured by the difference between the conscripts' below market wage income in the military and the potential market income if they were not forced to serve. One also needs to note that the pecuniary disutility includes also the extra risk of death or injury that military service may entail.

Not all economists are in favor of an all-volunteer force. Lee and McKenzie (1992) and Warner and Ash (1995) argue that under certain circumstances, an all-volunteer force is not feasible, for example due to aging and changing demography, or it could be more efficient than conscription if all-volunteer military forces are financed through high and distortionary taxes. Ng (2008) offers an alternative view opposed to almost unanimous preference for an all volunteer force among economists, and argues that the desirability of conscription cannot be completely excluded if the returns in military service are high (due to both training costs and learning by doing), and the required amount of military service is high (such as for a country at war).

With significant technological development in the military sector, and the end of the Cold

War, many European countries started to consider ending conscription. The all-volunteer example set by the United States and the United Kingdom do seem to play a role in the decision makings of European governments. Warner and Negrusa (2005) examine the conversion from conscription to a more volunteer force in the European countries with the extended theory of military manpower procurement system choice (Warner and Ash, 1996). Warner and Negrusa (2005) add the social costs of individuals' attempts to evade conscription and the government's cost of preventing it in the military manpower procurement model, and interpret their research results as that the higher these evasion costs are, the more likely that a government converts to an all volunteer military manpower. Warner and Negrusa (2005) find the decisions of many European countries to end conscription efficient and equitable. With the changing roles and missions of European militaries and the post Cold War downsizing, they argue that volunteer forces have lower real resource costs than conscripted forces.

A further branch of research focuses on why some countries use conscription while some do not. Mulligan and Shleifer (2004) find that countries with a higher population tend to use conscription more (holding the relative size of military constant). They also find that countries with a French legal origin, which they see as those facing lower fixed and variable administrative costs, are more likely to use conscription than countries with common law origins. Furthermore, they find that conscription does not seem to be influenced by democracy, but rather by the deadweight costs of taxation only in countries with very large militaries. They conclude that the fixed costs of introducing and administering new regulations may be an important determinant of the use of conscription.

Anderson, Halcoussis and Tollison (1996) argue that the strength and extent of the labor unions may be a determinant in government's choice of military procurement. They hypothesize that unions may expect to benefit from conscription in the same way that they prefer minimum wages. Both devices are meant to protect the lower skilled, younger members of the union. They find that in countries where the influence of labor unions is high the more likely it is to use military conscription.

Poutvaara and Wagener (2007) discuss Pareto efficiency in the abolishment of military draft as a form of intergenerational redistribution. They argue that introducing military conscription benefits the older generation while it harms the young and all future generations. In their view, military conscription distorts human capital formation more severely than an intergenerational transfer using public debt or pay-as-you-go pensions, therefore it can be abolished in a Pareto-improving way if age-dependent taxes are available. More specifically, they argue that the political allure to keep military conscription can be explained with the

absence of age-specific taxation.

2.2 Empirical Studies

The empirical work in the filed of military conscription focus largely on efficiency losses. I find that this research tends to be divided into three types of costs:

1. Static Costs: efficiency loss measured in terms of income (usually life-time earning or budgetary costs comparisons for a certain country in a certain period)

2. Dynamic: the effects of conscription through the channels of education and human capital accumulation. The dynamic costs tend to account for the indirect effects of conscription through human capital accumulation on economic performance, which provides framework for estimating the effects on military conscription

3. Other economic costs: for example social costs, which are hard to be measured, for example the evasion costs of conscription (e.g. costs in emigration, pretended schooling, bribing recruitment officers, faking medical records, etc.)

2.2.1 Static Cost of Military Conscription

Hansen and Weibrod (1967) are the pioneers in modeling the static costs of military conscription. Their theoretical model of implicit income taxes on eligible draftees is focused specifically on the allocative and distributive effects of conscription on real output, and on finding numerical values of such costs for the United States. The annual total distributive cost equals up to $990 million and the annual allocative cost equals up to $1120 millions. On the individual level, the difference in annual net forgone income (annual civilian income opportunities minus annual actual military compensation) equals $1480.

Angrist (1989) compares the lifetime earnings of the Vietnam War veterans and non-veteran. He uses instrumental variables estimates from the Social Security Administration records, and finds that in the early 1980s, the earnings of white veterans are approximately 15% less than non-veteran earnings. In an attempt to explain this loss of earnings to veterans, Angrist estimates the experience-earnings profiles jointly with time-varying veteran status coefficients. His estimates suggest that the effect of Vietnam era military conscription on white veterans is equivalent to a loss of two years of civilian labor market experience.

Bauer and Schmidt (2009) identify the causal effect of military conscription on conscripts' subsequent labor market outcomes in Germany during the 1950s with the regression-discontinuity design. Using the White Cohort (Weißer Jahrgang) as a control group (German and Austrian men who were born between 1929 and 1937, and exempted from compulsory military service), they find that people that served in conscription earn comparatively more, yet the earnings advantage and wage premium of those who serve in the armed forces vanish when the selection effects are taken into account. The observed earnings differentials could entirely be attributed to the way the conscripts are selected. They argue that healthier men are likely to contribute a better labor market outcome than their rejected or exempted counterparts (selection effect), and therefore 'it would be reasonable to say that conscripts would have earned more even without serving in the Bundeswehr.'

Imbens and Klaauw (1995) report the earning differentials between men who were selected to serve in conscription and those who were not in the Netherlands. They point out the complicated examination process of the selection in to the military draft, and numerous (temporary) exemptions that can be manipulated by young men to avoid military service. They find that approximately after 10 years of serving in the Dutch military (1989/1990), former conscripts earn on average 5% less than the members of their birth cohort who did not serve in the military. Furthermore, a comparison of this cost with the returns to one year of work experience indicates that serving in the military is roughly equivalent to the cost of losing one year of potential work experience.

Kunze (2002) explores the short and long run effects of career interruptions on (accepted) wages for young skilled workers in West Germany. Beside military conscription, the analysis includes three other types of career interruptions: unemployment, parental leave for female workers, and other non-work spells. For interruptions due to military conscription, Kunze finds that conscripted men earn 3.2% more in wage income during the first year after service term, but earn less afterwards than the non-conscripted men, and the gap in wages increases with time.

In terms of comparison with budgetary costs, Lutz (1996) finds that the annual monetarized utility loss from conscription equals 9-27% of the German defense expenditure. Kerstens and Meyermans (1993) estimate the social costs of the selective conscription in Belgium to be twice as large as its budgetary costs. They point out the complicated

examination process of the selection in to the military draft, and numerous (temporary) exemptions that can be manipulated by young men to avoid the draft.

2.2.2 Dynamic Costs

Lau et al. (2002) argue that conscription distorts output via two channels. The first channel is human capital accumulation. Young people (usually men) have to disrupt/postpone education or labor market experience. They argue that the time spent in compulsory military service depreciates their human capital, i.e., the knowledge and skills they gain from secondary education would be more or less lost during the service time. Hence the time gap dedicated to conscription interrupts and distorts the human capital accumulation and thus might reduce labor productivity. The lifetime earning research, e.g. the work of Kunze (2002) corroborates this.

The second channel is through capital accumulation. They share the view of conscription as form of in-kind tax as in Weisbrod et. Al (1967), and further suggest that this front-loaded in-kind tax is levied more one-sidededly on young people than 'normal monetary' taxation on general population to finance public expenditure.

To estimate the dynamic costs of conscription and other similar types of disruptions in human capital accumulation (such as alternative civilian service) via these two channels, they provide a dynamic general equilibrium model and computational simulations of steady-state output, with respect to the extent of conscription and taxation. Their findings suggest that conscription decreases output by 0.2% to 1% from its original steady-state.

Wagener and Keller (2009) hypothesize that military draft discourages demand for higher education. Using data from 1960-2000 for OECD countries, they find empirically that the scale and extent of conscription, measured in the share of conscripts to the labor force, and the duration of service time, do have significant negative effects on tertiary education enrollment rates.

The first large scale empirical work on the effect of conscription on economic performance is from Keller et al. (2009). Using an augmented Solow growth model and data from OECD countries from 1960-2000, they find that conscription and alternative service have negative and significant effects on income levels and economic growth.

2.2.3 Other Economic Cost

While the real social costs of conscription can hardly be measured, some empirical work does provide a useful insight. Bauer et al. (2011) focus on conscription in Germany, which was introduced in 1956 and where young men were able to postpone military service if they enrolled in universities. They argue that young men are drafted typically when they are at the height of their learning ability, and in order to continue their human capital accumulation in the hope for higher returns from civilian labor market later and also to avoid the draft, the demand for tertiary education might increase. Consistent with this, they find that conscription leads to an increase in the probability of having a university degree in Germany.

Galiani et al. (2006) provide relationships between conscription and crime. They find that the initiation in criminal activities is typically a 'young' phenomenon and argue that conscription, being one of the major events affecting the young, may have some causal effects on crime. Using data from Argentina, where selective conscription exists, they find that participation in military service increases the likelihood of developing a criminal record (particularly for property and weapon-related crimes) in adulthood.

Vasquez (2005) studies the relationship between conscription and military casualties. He finds that democracies with conscript armies experience fewer combat casualties than democracies with volunteer or professional forces, and argues that this is because societal actors most closely affected by conscript casualties are more likely to have the political power and access with which to constrain policy makers. Poutvaara and Wagener (2011) see the idea of conscription being more 'representative' of society in the military sector as a myth, because conscription covers less than half of the population and often excludes women, homosexuals, fathers and some religious groups. They argue that a conscript armed force is de facto biased in terms of the selection process, which includes legal and illegal buyout options.

Debates on links between conscription and the representativeness of the population, peace-keeping, and democracy are still open. Choi and James (2003) study the violent interstate conflicts from 1886 to 1992 and find that conscript armies are associated with more military disputes than a military manpower system with professional or voluntary forces. Anderson et al. (1996) conclude that war-like states are more likely to rely on conscription. Pfaffenzeller (2009) finds no empirical link between democracy and conscription, and finds conscription unnecessary in countries without threat.

3. Model and Data

3.1 The Augmented Solow Model

Following the work of Keller et al. (2009), the model used to estimate the income and growth effects of military conscription is an augmented Solow growth model. The production function can be written as:

$$Y(t)=A(t,m)K(t)^{\alpha}H(t)^{\beta}L(t)^{1-\alpha-\beta}$$

α, β, 1-α-β>0, i.e. all inputs receive a positive factor share. For year t, Y(t) denotes the gross domestic product, K(t) represents the amount of physical capital, L(t) represents non-augmented labor employed in production, and H(t) denotes human capital. The variable A(t,m) measures total factor productivity, which depends on m, a vector of military variables.

As in Mankiw et al. (1992), the labor force grows at an constant and exogenous rate n, and technology grows at a constant rate g. The economy is assumed to be on a balanced growth path, where constant shares s_k and s_h of GDP are devoted to investments in physical and human capital. By assuming an equal depreciation rate δ for both human and physical capital, one obtains:

$$\ln[Y(t)/L(t)] = \frac{1}{(1-\alpha-\beta)}\ln A(0,\mathbf{m}) - \frac{g\times t}{(1-\alpha-\beta)} - \frac{(\alpha+\beta)}{(1-\alpha-\beta)}\ln(n+g+\delta) + \frac{\alpha}{(1-\alpha-\beta)}\ln(s_k) + \frac{\beta}{(1-\alpha-\beta)}\ln(s_h) \quad (1)$$

This framework can be used to evaluate essentially any growth model that admits a balanced growth path, including endogenous growth models, as argued by Bernake and Gürkaynak (2001). A similar Solow-type approach was used by Knight et al. (1996) to test for the impact of military spending on economic growth.

In order to estimate the growth of per capita GDP, following Mankiw et al. (1992) and Keller et al. (2009), one can approximate equation (1) by a Taylor expansion around the steady state and solve the resulting differential equation, which results in:

$$\ln[Y(t)/L(t)] - \ln[Y(0)/L(0)] = (1-e^{-\lambda t})(\ln A(0,\mathbf{m}) + gt)$$
$$+(1-e^{-\lambda t})\frac{\alpha}{(1-\alpha-\beta)}\ln(s_k) + (1-e^{-\lambda t})\frac{\beta}{(1-\alpha-\beta)}\ln(s_h)$$
$$-(1-e^{-\lambda t})\frac{\alpha+\beta}{1-\alpha+\beta}\ln(n+g+\delta) - (1-e^{-\lambda t})\ln[Y(0)/L(0)] \qquad (2)$$

where $\lambda := (1-\alpha-\beta)(n+g+\delta)$ is the rate of convergence.

3.2 Data

In the analysis that follows I use the same 21 OECD countries for my sample, and extend the period one decade further. The vector m in the augmented Solow model mentioned above, is a assumed to be a vector of the following military variables:

Conscript Dummy Variable: this takes the value one if a country uses conscription (in a particular year). During transition time, when conscription is being abolished de jure but not de facto, the variable also takes the value one, as long as the number of conscripts is positive.

Conscripts/Armed Personnel is the ratio of conscripts to total armed personnel. If a country does not have any conscripts, the value is zero. As seen in Figure 3, there is a clear trend of decreasing shares of conscripts to total armed force in those 21 OECD countries since 1990. This control variable should indicate the effect of the composition of the armed force on economic performance, i.e. whether a larger share of conscripts depresses economic performance, or in other words, whether a more professionalized armed force is better for the economy.

Conscripts/Labor Force is the ratio of conscripts to the total labor force. This should measure the effect of the scope of conscription in the labor force. If conscription indeed hampers economic performance, then the larger the share of the conscripts to the labor force, the larger the negative effect it should have on income levels and growth.

Armed Force Personnel/Labor Force is the ratio of total armed force personnel to total labor force, i.e. the relative size of the armed force to the total labor force. It is a more general military variable, and should indicate the effect of the relative size of armed force.

Length of Conscription is the length of conscription measured in months. If the lengths of conscription vary among military branches, army, navy, and air force, the length is calculated as the weighted average of the service lengths from each branch, with respect to the composition of conscripts in each branch. If the composition of conscripts in each branch is unknown, and the lengths of conscription do vary among branches, the length of conscription is calculated as the weighted average of the of service lengths from each branch, assuming that conscripts are distributed identically as army, navy and air force in total armed force personnel. The value of length of conscription takes the value zero if a country does not use conscription.

Keller et al. (2009) include the lengths of alternative as a regressor. However, following the same source (WRI, EBCO, and OMHROI), I find that there is unfortunately no time series data on the lengths of alternative service, and so it is dropped from my estimations. The value of length of conscription takes the value zero if a country does not use conscription.

The conscript dummy variable, the numbers of conscripts and the total armed force are from the Military Balance of IISS (The International Institute for Strategic Studies, London).

To capture military environment, such as whether a country deploys armed force to national or international conflicts, and how much a country spends in military expenditure, I include the following two variables.

Conflict: is a dummy variable taking the value one if a country is involved in armed conflict(s) in that year, as defined by the Uppsala Conflict Data Program (UCDP, 2011) 'a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths'. The data are taken from UCDP and the International Peace Research Institute (PRIO, Oslo, 2011). Conflicts are for example the Vietnam War, Invasion of the Falkland Island, the war against terrorism in Iraq and Afghanistan.

Military Expenditure/GDP is the ratio of military/defense expenditure to GDP, which is taken from the World Development Indicators (2010) database of the World Bank. In the literature of defense economics, there is usually mixed results of the estimated ceteris paribus effects of this variable on economic growth (Frederiksen, 1983). Some say that it has no effect, such as Denne et al. (2004), and some say it has negative effects on growth (Knight et

al. 1996). Despite the findings that the relationship between defense spending with economic performance might be non-linear, as Heo (1998), Hooker and Knetter (1997) and Stroup and Heckelmann (2001) argue, I include this variable in my simple linear regression models, mostly because of the supposedly homogeneity in the OECD countries, and also following the conscription regression models by Keller et al. (2009).

Other non military variables, GDP, GDP per capita growth rate, labor force, investment proxy (gross capital composition as % of GDP), inflation rates, and population growth rates, are taken from the World Development Indicators (2010) databases of the World Bank.

I use basically the same data source as Keller et al. (2009), with exceptions of Population, and Education. Keller et al. (2009) use working-age population as a proxy for Population, whereas I use the total labor force. For Education, they use the average shares of the working-age population that is in secondary education, while I use the average years of secondary education from Barro and Lee (Educational Attainment for Aged 15 and Over, 2010). The missing values in the four-year gaps from Barro and Lee are calculated assuming that the changes in the average years of secondary education between each period change at the same rate. Since there is so far no convention in choosing a proxy for human capital, as discussed by Sianesi and Van Reenen (1992) and that there is essentially more data available from Barro and Lee (average school years) than with the data used by Keller et al. (2009), I use the education proxy from Barro and Lee.

Summary Statistics:

Table 1: Descriptive Statistics (Means of Variables of Interest)

	Without Conscription	With Conscription	All Countries
Conscripts /Armed Personnel	0	57.6%	32.5%
Conscripts/ Labor Force	0	0.1%	0.5%
Armed Personnel/Labor Force	0.75%	16.3%	12.7%
Length	0	13.508 months	8.488 months
Conflict	0.361	0.223	0.272
Military Expenditure /GDP	1.854%	2.051%	1.964%
Investment/GDP	22.4%	23.2%	22.9%
Population Growth Rate+ 0.05	0.059%	0.057%	0.058%
Education (secondary School Year)	3.621 years	2.562 years	2.935 years
Inflation Rate	4.2%	7.2%	6.2%
GDP/Labor Force	45309.25	39280.38	41749.35
GDP per capita Growth Rate	1.83%	2.27%	2.11%

Table 1 reports the descriptive statistics for the major variables in the dataset. For those observations where countries use conscription, the average ratio of armed personnel to the total labor force (16.3%) is much larger than that for the group without conscription (0.75%). Average military expenditure as a percentage in GDP is also higher for observations with conscription. On average 2.05% of GDP is spent on the military sector for observations with conscription, whereas observations without conscription spend less than 1.9% of GDP for military sector. The average investment ratio to GDP is slightly larger in countries with conscription. However, these differences may not be significantly different.

In terms of other variables, population growth is slightly larger and average years of secondary education is more than one year higher for countries that do not use conscription, results which are consistent with the findings of Keller et al. (2009). Interestingly, the observations without conscription have more conflicts on average. Income levels as measured in GDP by per unit of the labor force are higher on average in the observations that do not use

conscription, and the corresponding GDP per capita growth rate is lower.

The average inflation rate is higher in the sample of countries that use conscription. Keller et al. (2009) argue that higher inflation indicates the weaker ability of the government to tax, thus the government is more likely to use conscription as the main source to recruit military staff. Therefore I report in Table 2 the correlations (along with significance levels) between inflation and military variables. Inflation is indeed significantly positively correlated with all the military variables, with the highest correlation being with the ratio of conscripts to the labor force. The ratio of military expenditure to GDP is also positively and significantly correlated with all the military variables, and highest with respect to the ratio of total armed forces to the labor force. Conflict is negatively correlated with all the military variables, although not always significantly. It seems that countries with higher inflation rates rely more on conscription, and that countries which are involved in more conflicts rely more on professional soldiers.

Table 2: Correlation and Significance

	Inflation	Military Expenditure/GDP	Conflict
Conscription DV	0.172 ***	0.105 **	-0.1475 ***
Conscripts/Total Armed Personnel	0.331 ***	0.154 **	-0.1869***
Conscripts/Labor Force	0.593 ***	0.422 ***	-0.05
Total Armed Personnel/Labor Force	0.547 ***	0.596 ***	-0.054
Length	0.293 ***	0.298 ***	-0.064 *

Note: *, **, and *** denotes significance at the 10%, 5% and 1% levels respectively

4. Results

When estimating equation (1) and (2), I extend the augmented growth model of Mankiw et al. (1992) by adding six military variables, measuring the use of conscription and the relative size of military expenditure to GDP. The variable Military Expenditure/GDP is added to the conscription variables because it very likely affects the choice of military recruitment, i.e the size and composition of the military force. Instead of using military expenditure/GDP as an additional control variable as in Keller et al. (2009) in most of their estimations, I include it as one of the military variables to avoid potential multicollinearity problems.

Inflation and Conflict are added as additional control variables, as the inflation rate has often been shown to negatively affect economic growth (Barro (1996), Fountas et al. (2001)), and conflicts are likely to be the cause of demand for military output.

For both the income and growth estimations, I first report the regression results without any military variable for the sake of comparison, before reporting results when adding military variables one by one. This setup is then repeated for both income and growth estimations in the following four specifications, each including more control variables:

Specification I: Investment, Population Growth, Education, as in the model of Mankiw et al. (1992))+ Conflict

Specification II: Specification I+ Inflation Rates

Specification III: Specification II+ Country Fixed Effects

Specification IV: Specification III+ Year Fixed Effects

Note that all the ratio variables, and GDP per capita growth rates are multiplied by 100, for easier numerical interpretation

4.1 Income Levels

Table 3 reports OLS regression results for income levels under Specification I. The coefficients on population growth and education receive the expected signs, i.e. population growth has negative and education has positive effects on the level of income. In addition, the estimated coefficients of population growth rate and education are all significant from column

(1) to (7). The coefficient on investment, on the other hand, does not always receive the expected positive sign, for example in column (5) and (7). It is strange that the coefficients of investment change so much when military variables are added. The coefficients on conflict are always positive (although insignificant) in Table 3.

From column (2) to (7), one can see that enforcing military conscription depresses income, and all the estimates of military variables are negative and significant, holding all else constant. By having a conscription system, income per member of the labor force is depressed by 0.06% ceteris-paribus. In terms of the effects of military staff composition, as shown in column (3), the higher the percentage of conscripts to the total armed force the lower is income per member of the labor force (all else equal). Based on the estimated coefficient in column (3) and ceteris paribus assumption, if the total armed force personnel is staffed equally by conscripts and professionals, the income per labor force is depressed by about 0.045%; and if the armed force personnel is entirely consisted of conscripts, income per labor force is depressed by 0.09%. A one month increase in the spell of conscription duration depresses income per unit of the labor force by 0.01% (holding all else constant).

In column (4), the coefficient on the ratio of conscripts to the labor force indicates that if 10% of the labor force is forced to serve in conscription, income per unit of the labor force is depressed by 1.31% (holding all else constant). To see the effects of the total military personnel and expenditure on income, one can look at the estimates of Armed Force Personnel/Labor Force and Military Expenditure/GDP as in column (5) and (7). Holding all else constant, if 10% of the total labor force works in the military sector, income per labor force is depressed by 1.29%; and a 10% increase in military expenditure to GDP depresses income per labor force by 0.009%.

Table 3: Income Levels under Specification I

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Investment	0.00202	0.00216	0.00231	0.00196	-0.000425	0.00227	-0.1018**
	(0.00329)	(0.00320)	(0.00324)	(0.00314)	(0.00304)	(0.00304)	(0.00435)
Population Growth +0.05	-0.3479***	-0.362***	-0.353***	-0.3201***	-0.325***	-0.3581***	-0.2793***
	(0.02959)	(0.02946)	(0.02865)	(0.02719)	(0.02723)	(0.02754)	(0.03.721)
Education	0.312***	0.302***	0.301***	0.260***	0.259***	0.280***	0.291***
	(0.0111)	(0.0122)	(0.0123)	(0.0136)	(0.0128)	(0.0128)	(0.0155)
Conflict	0.0326	0.0258	0.0217	0.0136	0.0138	0.0210	0.00882
	(0.0254)	(0.0257)	(0.0256)	(0.0237)	(0.0233)	(0.0251)	(0.0281)
Conscript DV		-0.0614**					
		(0.0271)					
Conscripts/Armed Force			-0.00098**				
			(0.00042)				
Conscripts/Labor Force				-0.131***			
				(0.0168)			
Armed Force/Labor Force					-0.129***		
					(0.0140)		
Length						-0.0105***	
						(0.00207)	
Military Expenditure/GDP							-0.000968***
							(0.000169)
Constant	11.38***	11.53***	11.48***	11.49***	11.66***	11.62***	11.55***
	(0.174)	(0.183)	(0.174)	(0.160)	(0.159)	(0.169)	(0.195)
Observations	629	629	627	627	625	628	461
R-squared	0.610	0.614	0.614	0.646	0.656	0.628	0.589
F-stat	215.1	189.3	193.4	295	255.9	225.9	111.4

Note: *(**)[***] denotes significance at the 10%, (5%), [1%] level; robust standard errors in parentheses

By adding the inflation rate as a control variable, Table 4 reports the results of the income equation for specification II. The coefficients on population growth rate and education still have the expected signs, and are always significant. The coefficients on investment are estimated to be mostly positive though insignificant in columns (1) to (6), while in column (7) the coefficient is estimated to be negative. The coefficient on the inflation rate is found to be negative, as economic theory predicts, and is always significant. The coefficients on conflicts are positive, and mostly significant except in columns (5) and (7).

Few things change in the coefficients of the conscription variables once inflation is added: The coefficients on the conscript dummy and conscripts/armed force change signs, although their coefficients are insignificant (columns (2) and (3)), while Length remains negative but loses significance at conventional confidence levels (column (6)).

Among the remaining three negative and significant coefficients, the largest is the share of armed personnel to the labor force (column (5)), a 10% increase of which reduces GDP per unit of the labor force by more than 0.7%. The second largest effect is from the share of conscripts to the labor force (column (4)), a 10% increase of which depresses GDP per labor force by more than 0.5%. The coefficient on the ratio of military expenditure to GDP has the smallest negative and significant coefficient under Specification II, a 10% increase in military expenditure decreases GDP per labor force by 0.005% ceteris paribus.

Table 4: Income Levels under Specification II

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Investment	0.002991	0.003	0.00293	0.00269	0.00119	0.00286	-0.00577
	(0.00306)	(0.00306)	(0.0031)	(0.00301)	(0.00296)	(0.0030)	(0.00426)
Population Growth +0.05	-0.2040***	-0.2038***	-0.1958***	-0.2130***	-0.2190***	-0.2154***	-0.1784***
	(0.03228)	(0.0341)	(0.03385)	(0.03164)	(0.03152)	(0.03299)	(0.03953)
Education	0.220***	0.220***	0.222***	0.209***	0.206***	0.213***	0.227***
	(0.0153)	(0.0156)	(0.0156)	(0.0157)	(0.0154)	(0.0155)	(0.0191)
Conflict	0.0496**	0.0496**	0.0532**	0.0402*	0.0366	0.0499**	0.0364
	(0.0246)	(0.0249)	(0.0252)	(0.0244)	(0.0240)	(0.0247)	(0.0276)
Inflation	-0.01748***	-0.01748***	-0.01806***	-0.01502***	-0.01415***	-0.01680***	-0.01432***
	(0.00190)	(0.00194)	(0.00202)	(0.00192)	(0.00179)	(0.00198)	(0.00192)
Conscript DV		0.000643					
		(0.0258)					
Conscripts/Armed Force			0.000464				
			(0.000394)				
Conscripts/Labor Force				-0.0578***			
				(0.0180)			
Armed Force/Labor Force					-0.0760***		
					(0.0136)		
Length						-0.00303	
						(0.00216)	
Military Expenditure/GDPMilitary Expenditure/GDP							-0.000512***
							(0.000153)
Constant	10.96***	10.96***	10.90***	11.08***	11.22***	11.07***	11.08***
	(0.160)	(0.180)	(0.172)	(0.165)	(0.165)	(0.174)	(0.187)
Observations	620	620	618	618	616	619	460
R-squared	0.682	0.682	0.683	0.687	0.695	0.685	0.636
F-stat	257.2	214.2	205.2	283.3	284	228.3	203.7

Note: *(**)[***] denotes significance at the 10%, (5%), [1%] level; robust standard errors in parentheses

As Table 2 shows, the inflation rate is positively and significantly correlated with all military variables. Once inflation is added as a control variable, three of six military variables lose their significance, with two of them changing signs. One possible explanation might be due to omitted variable bias. Since I do not have data on alternative military service, the conscription dummy is likely to capture some of the effect of alternative service. The effects of alternative service are argued by Keller et al. (2009) to be negative, following the same logic of differences in comparative advantages. Among the 21 OECD countries that use conscription, most of them also offer alternative service to conscientious objectors. The positive sign of conscript DV in column (2) in Table 4 might somehow capture some (positive) effects from alternative service in the public and social sectors, once inflation is controlled for. Furthermore, inflation can perhaps be seen as a proxy for deadweight loss in taxation, as argued by Keller et al. (2009). Countries with higher inflation may be less able to staff armed force adequately with professional soldiers, and may thus be more prone to conscription. (Table 2 shows positive and significant correlation between inflation rates and all the conscription variables.) However, given the rather homogenous sample of developed countries, the argument that higher inflation implies more deadweight loss in taxation and thus more intense conscription use, may not apply. Another possible explanation is the time horizon. The decrease in the ratio of conscripted soldiers to total armed force happened only after 1990, as Figure 3 shows. It might be that two decades are not enough to fully exhibit the effects of the intensity of conscription in terms of the share of conscripts to the armed force, as in column (3) of Table 4.

Table 5: Income Levels under Specification III

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Investment	0.00205	0.00257	0.00266	0.00203	0.00154	0.00208	0.00416***
	(0.00168)	(0.00168)	(0.00172)	(0.00169)	(0.00158)	(0.0017)	(0.00159)
Population Growth+ 0.05	0.03518*	0.03807**	0.04036**	0.03530**	0.03113*	0.03522*	0.03054*
	(0.0180)	(0.01747)	(0.01758)	(0.01797)	(0.01672)	(0.01798)	(0.01804)
Education	0.164***	0.173***	0.177***	0.161***	0.109***	0.166***	0.102***
	(0.0156)	(0.0186)	(0.0206)	(0.0219)	(0.0162)	(0.0185)	(0.0252)
Conflict	0.0783***	0.0830***	0.0819***	0.0774***	0.0648***	0.0796***	0.0485***
	(0.0129)	(0.0128)	(0.0128)	(0.0123)	(0.00937)	(0.0124)	(0.0113)
Inflation	-0.00676***	-0.00664***	-0.00692***	-0.00667***	-0.00502***	-0.00682***	-0.00387***
	(0.00105)	(0.00107)	(0.00107)	(0.00106)	(0.000832)	(0.00105)	(0.000793)
Conscript DV		0.0586**					
		(0.0232)					
Conscripts/Armed Force			0.000928*				
			(0.000484)				
Conscripts/Labor Force				-0.00830			
				(0.0243)			
Armed Force/Labor Force					-0.115***		
					(0.0189)		
Length						0.000788	
						(0.00181)	
Military Expenditure/GDP							-0.00114***
							(0.000156)
Constant	9.854***	9.777***	9.959***	9.350***	9.595***	9.842***	10.28***
	(0.111)	(0.120)	(0.100)	(0.103)	(0.104)	(0.123)	(0.137)
Observations	620	620	618	618	616	619	460
R-squared	0.957	0.958	0.957	0.957	0.963	0.957	0.977
F-stat	625.6	592.2	563.3	629.3	706.3	592.8	1497.4

Note: *(**)[***] denotes significance at the 10%, (5%), [1%] level; robust standard errors in parentheses

Table 5 introduces country fixed effects in to the previous regression model. When doing so we observe that the coefficients on investment always have the expected positive signs, with the coefficients being significant in all cases except column (7). The coefficients on inflation and education not only always have the expected signs, but are also always significant. Notably, the coefficients of population growth rate and the presence of conflicts are all significantly positive, once country fixed effects are added to the specification.

When adding country fixed effects, enforcing conscription has positive and significant effects in terms of the conscription dummy (column (2)) and the share of conscripts to armed force (column (3)). Having a conscription system increases GDP per unit of the labor force by more than 0.05% (significant at the 5% level), and a 10% increase in the share of conscripts to the armed force increases GDP per unit of the labor force by 0.009% (significant at the 10% level).

The more general military variables, i.e. the relative size of the armed forces to the labor force, and the relative share of military expenditure to GDP, both remain negative and significant at the 1% level (columns (5) and (7)).

Compared with the results from a similar specification in Keller et al. (2009), Table 5 shows a number of differences. In the paper of Keller et al (2009) all estimated coefficients on the conscription variables are negative, and mostly significant. Moreover, the coefficient on the share of military expenditure to GDP is estimated to have almost no effect on income levels. The new variable I add, the share of conscripts to the armed force is estimated to be negative yet insignificant at conventional confidence levels.

One explanation for the positive signs and significance of the coefficients on the conscript dummy and the share of conscripts to armed force could be that by adding country fixed effects, the omitted variable issues are removed to a certain extent, and the country specific characteristics are captured. The effects of enforcing conscription seem to be mixed and hard to explain once country fixed effects are added to the estimation.

Table 6: Income Levels under Specification IV

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Investment	0.00659***	0.00785***	0.00776***	0.00790***	0.00867***	0.00769***	0.00828***
	(0.00136)	(0.00131)	(0.00133)	(0.00136)	(0.00139)	(0.00140)	(0.00149)
Population Growth+0.05	0.00774	0.01123	0.01700	0.00312	0.00409	0.00705	0.02233*
	(0.01187)	(0.01089)	(0.01128)	(0.01122)	(0.01124)	(0.0112)	(0.01.17)
Education	0.00228	0.0124*	0.0213***	0.0192**	0.0118	0.0122*	-0.00556
	(0.00760)	(0.00654)	(0.00667)	(0.00750)	(0.00719)	(0.00652)	(0.0119)
Conflict	-0.0103	-0.00567	-0.00608	-0.0110	-0.00925	-0.00605	-0.0155**
	(0.00750)	(0.00697)	(0.00689)	(0.00737)	(0.00709)	(0.00704)	(0.00724)
Inflation	-0.00244***	-0.00214***	-0.00268***	-0.00299***	-0.00248***	-0.00270***	-0.00305***
	(0.00067)	(0.000632)	(0.00667)	(0.000756)	(0.000711)	(0.000657)	(0.000573)
Conscript DV		0.0950***					
		(0.00988)					
Conscripts/Armed Force			0.00181***				
			(0.000243)				
Conscripts/Labor Force				0.0571***			
				(0.0138)			
Armed Force/Labor Force					0.0465***		
					(0.0110)		
Length						0.00582***	
						(0.000978)	
Military Expenditure/GDP							-0.000116
							(0.000103)
Constant	10.58***	10.47***	10.40***	10.50***	9.308***	10.51***	9.348***
	(0.0773)	(0.0717)	(0.0770)	(0.0807)	(0.0785)	(0.0747)	(0.0928)
Observations	620	620	618	618	616	619	460
R-squared	0.984	0.986	0.986	0.985	0.986	0.985	0.990
F-stat	823.3	925.7	834.9	742.8	758.6	805.8	1223.67

Note: *(**)[***] denotes significance at the 10%, (5%), [1%] level; robust standard errors in parentheses

Table 6 reports the results of the income regressions under specification IV, where time dummies are additionally included in the model. Inflation rates are always found to have a negative and significant effect on the income level (significant at the 1% level), and investment always has a positive and significant effect (at the 1% level). The presence of conflicts has mostly negative and insignificant effects, while population growth rates have a positive and mostly insignificant effect when year fixed effects are added. All the coefficients on military variables become positive and highly significant (at 1%) in specification IV, except for the share of military expenditure to GDP which is negative and insignificant.

Year fixed effects control for time-specific heterogeneity (i.e. world business cycles). They are also likely to capture the impacts of technological and organizational improvements in the military sector (and elsewhere), developments in military strategy, the advent of military adventurism and joint missions, and historical events, etc. Surprisingly, when adding year fixed effects, all the conscription variables are estimated to be positive and significant. This is difficult to explain with the classic economic theory of comparative advantages alone. Further research on the relationships between these time-specific impacts and conscription should shed more light on the effects of conscription on income levels.

Table 7: Summary of Income Regression Results

	I	II	III	IV
Conscript DV	- **	+	+ **	+ ***
Conscripts/Armed Force	- **	+	+ **	+ ***
Conscripts/Labor Force	- ***	- ***	-	+ ***
Armed Force/Labor Force	- ***	- ***	-***	+ ***
Length	- ***	-	+	+ ***
Military Expenditure/GDP	- ***	- ***	- ***	-

In Table 7, I report the signs and significance levels of the military variables from all four specifications. Looking at the columns from left to right, one can see that deviating from the augmented Solow model by adding more control variables, and in particular when adding country and time fixed effects, the conscription variables lose their significance, and usually change signs from negative to positive. Only under specification I are all conscription and

military variables negative and significant.

4.2 Growth Rates

This section reports results from OLS regressions estimating Equation (2). In my analysis I use data on annual growth rates, whereas Keller et al. (2009) use decadal average growth rates. To estimate Equation (2), one needs to account for the initial income level. Keller et al. (2009) use the GDP per capita in 1960 as a regressor in their growth estimations. One problem with the initial per capita GDP term is that it is not possible to estimate the coefficient on this variable when country fixed effects. In order to compare results across the different specifications therefore I choose to drop the initial per capita GDP term in all models. Time-invariant, country-specific factors – such as the initial income term – will be captured by the country fixed-effects in specifications III and IV however.

Table 8: Growth under Specification I

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Investment	0.1331***	0.1329***	0.1230***	0.1227***	0.1229***	0.1229***	0.1794***
	(0.02263)	(0.02268)	(0.02674)	(0.02966)	(0.03006)	(0.02304)	(0.04119)
Population Growth+0.05	-0.356*	-0.3946**	-0.4415*	-0.2663	-0.3244	-0.2059	-0.4334
	(0.1928)	(0.1977)	(0.2307)	(0.2153)	(0.2284)	(0.1862)	(0.2804)
Education	-0.376***	-0.420***	-0.211**	-0.241**	-0.174	-0.299***	-0.232*
	(0.0786)	(0.0809)	(0.0927)	(0.112)	(0.126)	(0.0817)	(0.140)
Conflict	-0.356*	-0.382*	-0.533**	-0.602***	-0.565**	-0.427**	-0.856***
	(0.203)	(0.206)	(0.221)	(0.226)	(0.225)	(0.200)	(0.227)
Conscript DV		-0.263					
		(0.195)					
Conscripts/Armed Force			-0.00595*				
			(0.00322)				
Conscripts/Labor Force				-0.179			
				(0.159)			
Armed Force/Labor Force					-0.0345		
					(0.146)		
Length						0.0153	
						(0.0145)	
Military Expenditure/GDP							0.00182
							(0.00138)
Constant	2.407**	2.947**	2.631**	1.663	1.683	1.413	1.100
	(1.115)	(1.226)	(1.199)	(1.162)	(1.251)	(1.075)	(1.464)
Observations	880	880	778	635	624	859	480
R-squared	0.112	0.113	0.076	0.068	0.064	0.098	0.110
F-stat	21.78	17.67	9.496	7.934	7.343	15.04	11.25

Note: *(**)[***] denotes significance at the 10%, (5%), [1%] level; robust standard errors in parentheses

Table 8 reports results from growth regressions under specification I. The coefficients on population growth and investment have the expected signs, negative and positive respectively, though the coefficients on population growth are not significant in column (4) to (7). Education has surprisingly all negative and significant coefficients, though this has been found else where (Angrist and Krueger (1991), and Benhabib and Spiegel (1994), Gemmell (1996) Krueger and Lindahl (2001), and Pritchett (2011)). The conflict variable is found to have a consistently negative and significant effects in specification I.

The coefficients on the conscript dummy, the share of conscripts to the labor force, and the share of armed force to the labor force are all negative, but not significant at conventional levels (column (2), (4), and (5)). The coefficients on length and on the share of military expenditure to GDP are positive and insignificant (column (6) and (7)). In fact, the only significant coefficient amongst the military variables is the share of conscripts to the total armed force (column (3)), with a coefficient of -0.00595 that is significant at the 10% level. In this specification, a 10% increase in the share of conscripts to total armed force depresses economic growth by around 0.006%, holding all constant.

When adding the inflation rate (Table 9), the signs of the coefficients on investment, population growth and the presence of conflicts are as expected. The coefficients on education continue to have the negative signs, and are always significant. The presence of conflicts have mostly negative and significant effects on the GDP growth rates per capita, holding all else constant.

The only significant military variable in specification II is the length of conscription, with a coefficient of 0.0262 (significant at the 10% level in column (6)). A one month increase in the duration of conscription increases GDP growth rate per capita by 0.0262%, holding all else constant. The coefficient on the share of conscripts in total armed force is still negative, but loses significance when the inflation rate is added to the regression.

Table 9: Growth under Specification II

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Investment	0.1408***	0.1400***	0.1220***	0.1247***	0.1271***	0.1316***	0.1819***
	(0.02157)	(0.02161)	(0.02680)	(0.02982)	(0.03034)	(0.02177)	(0.04181)
Population Growth+0.05	-0.1034	-0.1413	-0.1749	-0.07023	-0.09.564	1.099	-0.33.53
	(0.2124)	(0.2231)	(0.2920)	(0.2442)	(0.2490)	(0.1988)	(0.3006)
Education	-0.577***	-0.610***	-0.315**	-0.297**	-0.254*	-0.475***	-0.280*
	(0.0901)	(0.0947)	(0.125)	(0.136)	(0.147)	(0.0935)	(0.160)
Inflation	-0.06118***	-0.06040***	-0.03317	-0.02389	-0.02663	-0.06706***	-0.01207
	(0.01808)	(0.01814)	(0.02259)	(0.02650)	(0.02536)	(0.01841)	(0.02737)
Conflict	-0.259	-0.266	-0.515**	-0.608***	-0.573**	-0.368*	-0.845***
	(0.210)	(0.211)	(0.223)	(0.231)	(0.229)	(0.203)	(0.229)
Conscript DV		-0.187					
		(0.208)					
Conscripts/Armed Force			-0.00300				
			(0.00350)				
Conscripts/Labor Force				-0.0330			
				(0.191)			
Armed Force/Labor Force					0.0784		
					(0.163)		
Length						0.0262*	
						(0.0144)	
Military Expenditure/GDP							0.00208
							(0.00138)
Constant	1.789	2.246	1.585	0.745	0.574	0.287	0.662
	(1.218)	(1.402)	(1.359)	(1.243)	(1.319)	(1.164)	(1.529)
Observations	862	862	760	626	615	841	479
R-squared	0.142	0.142	0.085	0.073	0.071	0.135	0.111
F-stat	22.37	18.75	8.876	6.858	6.421	17.01	9.335

Note: *(**)[***] denotes significance at the 10%, (5%), [1%] level; robust standard errors in parentheses

Table 10: Growth under Specification III

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Investment	0.3361***	0.3411***	0.3508***	0.4058***	0.4064***	0.3362***	0.4746***
	(0.03226)	(0.03244)	(0.03429)	(0.04224)	(0.04427)	(0.03285)	(0.05618)
Population Growth+0.05	-1.541***	-1.530***	-1.516***	-2.013***	-2.037***	-1.492***	-2.615***
	(0.2040)	(0.2042)	(0.2289)	(0.2603)	(0.2691)	(0.2514)	(0.2834)
Education	-0.503***	-0.418***	0.0272	0.217	-0.0816	-0.269**	-0.485
	(0.114)	(0.125)	(0.164)	(0.258)	(0.267)	(0.137)	(0.371)
Inflation	-0.1373***	-0.1376***	-0.1375***	-0.1298***	-0.1187***	-0.1398***	-0.06241
	(0.01831)	(0.01829)	(0.02576)	(0.03062)	(0.03261)	(0.01861)	(0.04029)
Conflict	-0.521***	-0.529***	-0.737***	-0.878***	-0.860***	-0.660***	-1.035***
	(0.198)	(0.197)	(0.211)	(0.221)	(0.225)	(0.197)	(0.243)
Conscript DV		0.509*					
		(0.291)					
Conscripts/Armed Force			0.0189***				
			(0.00678)				
Conscripts/Labor Force				0.957**			
				(0.411)			
Armed Force/Labor Force					0.242		
					(0.377)		
Length						0.0544***	
						(0.0179)	
Military Expenditure/GDP							-0.00747**
							(0.00319)
Constant	4.015***	2.978**	4.637***	1.263	3.647	5.519***	12.45***
	(1.270)	(1.386)	(1.322)	(2.287)	(2.724)	(1.297)	(1.780)
Observations	862	862	760	626	615	841	479
R-squared	0.309	0.310	0.280	0.283	0.282	0.301	0.334
F-stat	11.87	11.57	8.843	7.645	6.725	10.63	7.956

Note: *(**)[***] denotes significance at the 10%, (5%), [1%] level; robust standard errors in parentheses

In Table 10 country fixed effects are added as control variables. The coefficients on investment, the population growth rates, and the inflation rates have the expected signs and mostly significant. The ceteris paribus effect of average years in secondary schooling is mixed, and not always significant, with positive signs found in column (3) and (4). Notably the presence of conflicts has a consistently negative and significant effect on growth rates.

All the coefficients on conscription variables are positive, and most of them are significant except for the share of armed force to the labor force. The largest positive effect among the conscription variables is the share of conscripts in the labor force (column (6)), with results indicating that a 1% increase in its share increases GDP per capita growth rate by 0.957% . The second largest positive effect among the significant conscription variable is the conscript dummy (column (2)), if a country enforces conscription, its GDP per capita growth rate increases by 0.509% compared with the scenario where it employs a fully volunteer armed force.

When country fixed effects are included the coefficient on military expenditure/GDP becomes negative and significant (column (7)). A 10% increase in the share of military expenditure to GDP decreases per capita GDP growth rate by 0.07%.

It appears that by adding country fixed effects, and thereby taking initial income levels and other country-specific, time invariant factors into account, conscription variables have a positive effect on economic growth.

Table 11: Growth under Specification IV

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Investment	0.2784***	0.2778***	0.2877***	0.2971***	0.2978***	0.2828***	0.3436***
	(0.02895)	(0.02938)	(0.03188)	(0.03952)	(0.04061)	(0.02975)	(0.05992)
Population Growth+0.05	-1.282***	-1.282***	-0.9785***	-1.368***	-1.365***	-1.137***	-1.745***
	(0.1884)	(0.1884)	(0.2360)	(0.2465)	(0.2498)	(0.2226)	(0.2892)
Education	-0.177	-0.181	-0.148	0.0264	-0.116	-0.198	-0.647**
	(0.177)	(0.173)	(0.178)	(0.248)	(0.238)	(0.159)	(0.272)
Inflation	-0.1100***	-0.1099***	-0.1323***	-0.1230***	-0.1166***	-0.1133***	-0.08725***
	(0.02102)	(0.02104)	(0.02422)	(0.02824)	(0.02811)	(0.0210)	(0.03277)
Conflict	0.0906	0.0944	0.0203	0.0890	0.103	-0.128	-0.191
	(0.207)	(0.205)	(0.214)	(0.223)	(0.219)	(0.204)	(0.254)
Conscript DV		-0.0442					
		(0.234)					
Conscripts/Armed Force			0.0155***				
			(0.00567)				
Conscripts/Labor Force				0.650*			
				(0.358)			
Armed Force/Labor Force					0.490		
					(0.360)		
Length						0.0139	
						(0.0189)	
Military Expenditure/GDP							-0.000325
							(0.00324)
Constant	4.393*	4.475*	1.197	2.458	1.178	9.540**	11.88***
	(2.510)	(2.596)	(1.459)	(2.050)	(2.403)	(3.721)	(2.058)
Observations	862	862	760	626	615	841	479
R-squared	0.540	0.540	0.540	0.560	0.556	0.541	0.607
F-stat	11.80	11.89	.	.	11.37	11.19	13.09

Note: *(**)[***] denotes significance at the 10%, (5%), [1%] level; robust standard errors in parentheses

Table 11 adds year fixed effects. The coefficients on investment, population growth rate, and the inflation rate have the expected signs and are always significant in this specification. The coefficients on education are mostly negative, with the exception of column (5). The coefficients on the presence of conflicts all have positive signs but are insignificant in Table 11.

The coefficient on the conscript dummy changes sign when year fixed effects are added, but is insignificant (column (2)). The coefficients on the share of armed force to the labor force and the length of conscription (column (5) and (6)) are still positive but lose their significance when year fixed effects are controlled for. The coefficient on the share of conscripts to the labor force (column (5)) is still positive and significant, but is smaller compared with that in specification III (with a coefficient of 0.957). When year fixed effects are added, a 1% increase in the share of conscripts to the labor force increase GDP per capita growth rate by 0.65%.

Table 12 Summary of Growth Regression Results:

	I	II	III	IV
Conscript DV	-	-	+ *	-
Conscripts/Armed Force	- *	-	+ ***	+ ***
Conscripts/Labor Force	-	-	+ **	+ *
Armed Force/Labor Force	-	+	+	+
Length	+	+ *	+ ***	+
Military Expenditure/GDP	+	+	- **	-

I summarize the signs and significance levels of the growth regressions in Table 12. In general, military and conscription variables exhibit mixed signs. In the first two specifications, most of the conscription variables are estimated to be negative, although rarely significant. Adding country fixed effects, the conscription variables show positive and statistically significant effects on economic growth. In specification IV, most of the conscription variables remain positive except for the conscript dummy, with only conscripts/labor force remains significant. It is to be noted that the duration of conscription spell remains positive in all four specifications, although not always significant.

Specification III and IV are the most likely candidates for estimation of Equation (2) in my growth regressions, because country fixed effects should capture differences in initial GDPs. Comparing the summary results from specification III and IV, most conscription variables lose their significance, with the conscript dummy changing its sign. Interestingly, all the conscription variables are estimated to be positive and significant in specification III. It is puzzling and difficult to explain these results with only the classic theories which suggest that conscription hampers economic growth. Furthermore, even though I use the same 21 OECD countries as Keller et al. (2009), I do not find consistently negative and significant effects of conscription on economic growth as they do.

It seems that when fixed effects are added, conscription has a positive though not always significant effect on economic growth. By adding fixed effects, the problem of omitted variables (i.e. alternative service) should be removed to a certain extent, yet the results from specification III and IV still present the unexpected positive effect of conscription.

4.3 Sensitivity Test

An important issue related to my analysis is that the use of conscription may be an endogenous variable. Warner and Ash (1996), Warner and Negrusa (2005) and Mulligan and Shleifer (2005) aim at explaining why some countries use conscription and some rely on professional armed force. More precisely, they are interested in whether there is reverse causality from income to conscription.

It could be that richer countries do not use conscription, while poorer countries cannot afford a fully professional armed force. However, Mulligan and Shleifer (2005) do not find any statistical significance for an impact of a country's per-capita income on the choice of military recruitment system. They argue that the choice of conscription might be correlated with a high administrative burden that is to be found with a French civil-law legal origin.

Keller et al. (2009) test for Granger causality in their cross-country results to investigate the possibility of reverse causality. The null hypothesis of no Granger causality cannot be rejected at the 5% confidence level for many countries. More specifically, the results are mixed. For some countries (Austria, France, and Greece), the length of conscription and the share of conscripts in the labor force Granger cause growth. In Sweden, income Granger

causes the share of conscripts in the labor force, and growth Granger causes the duration of conscription.

As for my results, since the conscription variables are neither consistently negative, as the theory of comparative advantage suggest, nor are they consistently negative and significant as in Keller et al. (2009), I do not test for Granger causality by country. Instead, I conduct least absolute value (LAV), or least absolute deviation estimation, to reduce the influence of potential outliers. To do this, I check the results from quantile regressions for all the income and growth estimations, and then compare the signs and significance levels of military variables with the OLS results reported in the section above.

By and large, most of the coefficients from LAV and OLS share the same signs and significance with few exceptions. The major exceptions are that in the income regression under specification II, military expenditure/GDP is positive and insignificant in OLS, but negative and highly significant in LAV, while in the growth regression under Specification IV, the conscript dummy is insignificantly negative in OLS and significantly positive in LAV at 1% level.

5 Conclusion

The effect of military conscription on economic performance is predicted to be associated with static inefficiencies as well as with dynamic distortions of human and physical capital. Examining panel data from 21 OECD countries from 1960 to 2010 shows however inconsistent results, especially when fixed effects are added.

Military conscription is measured by the conscription dummy variable, the share of conscripts to the armed force, the share of conscripts in the labor force and the length of service time. To see the effects of more general military sector, the relative size of the armed force to the labor force and the relative size of military expenditure to GDP are also added.

To control for the demand for military output I include a conflict variable, which is a dummy variable and takes the value one if a country is involved in domestic or international conflict. The ceteris paribus effect of this variable is mixed. On income levels, which are measured by GDP per unit of labor force, the coefficient of conflict is estimated to be mostly zero, and sometimes significantly positive. Whereas on growth rates, which is the GDP per capita growth rate, the coefficient of conflict is mostly significant and negative, and only rarely zero.

The more general military variables, namely the share of military spending to GDP and the share of military personnel to the labor force, have more consistent ceteris paribus effects in my regressions. The relative size of the armed force to the labor force always receives the negative sign in income regressions, and is always significant at the 1% level, whereas in growth regressions it is estimated to have no effect. The coefficient of the ratio of military expenditure to GDP is estimated to have negative and significant effects on income levels, and has mixed results in growth regressions. In the literature on defense economics, military spending has pretty mixed effects on economic growth. The relative size of the armed force, however, has not yet been extensively considered. My results suggest that in OECD countries, the larger the share of the labor force working in the military sector, the lower the income levels are, holding all else constant.

The ceteris paribus effects of conscription variables on income levels (GDP per unit of labor force) and economic growth (GDP per capita growth rate) are not consistently negative when country and year fixed effects are included in the regressions. Compared with the consistently negative and significant results of Keller et al. (2009), this is much of a surprise.

Among the conscription variables, the share of conscripts to the labor force is one of the

particular interests in this thesis. According to the computational general equilibrium by Lau et al. (2004), the larger this share is, the more it depresses the income level from its steady state level. In my income panel results, this variable is estimated to be negative and significant only without fixed effects. One needs to note that, in the work of Lau et al. (2004), supplementary tax rates are part of the determinants of the equilibrium outcomes. In my simple regression models, tax rates are not included.

Another conscription variable of special interest in this thesis is the share of conscripts to the armed force personnel. The larger this share is, the more negative effects it should have on economic performance according to the mainstream economic theory on conscription. This variable is supposed to measure directly the dyad of conscripts-all volunteer force. In my results, this variable is only estimated to be negative and significant without inflation and fixed effects. When fixed effects are added, its coefficient become positive and significant (for both income and growth regressions).

The expected negative effects, due to ignorance of comparative advantage among conscripts and the accompanying opportunity costs, vanish when country and year fixed effects are added. This is difficult to explain, yet I summarize possible explanations and ideas for future research:

1. Time Horizon. Given the relative young movement of abolishment of conscription in Europe, which starts in 1990, it is likely that two decades are not enough to reflect the true effects of the intensity of conscription, i.e., the share of conscripts to the armed force and to the labor force, and the length of compulsory military service.

2. Space Horizon. Although the political disputes of conscription occur mainly in OECD countries, the relationship between conscription and economic performance is also interesting for developing countries and rest of the world. A wider sample can shed more light on the subject.

3. Omitted Variable Bias:

i.) Alternative service is argued to depress economic performance in the same way as compulsory military service. There is no time-series data of the intensity and length of alternative service, therefore the conscription dummy variable may capture some of the effects from alternative service, which might be more valuable to society as mainstream economic theory predicts.

ii.) Taxation. To finance an all-volunteer armed force, government needs to rely on more taxation than relying on military conscription. The allocative aspect of taxation may be influencing the economic effects of conscription. Poutvaara and Wagener (2005) argues that the abolishment of military conscription may bring Pareto-improvement to the society if generation-specific tax can be enforced, more specifically, on the young generations, however this is rather infeasible. They also show that the introduction of conscription benefits the older generations while harming the younger and future generations, and abolishment of conscription without generation-specific taxation would not necessary mean Pareto improvement for the society. These inter-generational aspects of Pareto efficiency may help to explain the unexpected signs of conscription variables in my results.

3. Specification of regression models. Perhaps the relationship between the conscription variables and economic performance may be non-linear, just as defense spending is argued to be non-linear to economic growth by Hooker (1997), Heo (1998), and Heckelman (2001). For future research, quadratic relationships, for example, should be considered. It could be that conscription is beneficial to economic performance to a certain degree, with some turning point percentage which measures the intensity of conscription, such as the share of population serving in the compulsory service to the labor force or armed personnel.

4. Difficulty to separate other determining effects. For example, the advent of internet, the fall of communism, the rise of military adventurism, the development in military technology, etc. The new landscape for the military sector can be determinant in the relationship between conscription and economic performance as well.

To conclude, examining panel data from 21 OECD countries, conscription does not have robust negative effects on economic performance, when fixed effects are added. The mainstream economic theory that favours an all-volunteer force due to ignorance of comparative advantage and increased opportunity costs cannot find full empirical support from my estimates. The effects of military conscription on economic performance still need to be further investigated.

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Data Source

Variables	Data Source	Version
Conscription Dummy, Length of Conscription, Number of Conscripts	Military Balance from IISS (The International Institute for Strategic Studies)	1960-2011
Education-average years of secondary schooling in total population	Barro & Lee	2010
Conflict	UCDP (Upssala Conflict Data Program) and PRIO (Peace Research Institute, Oslo)	2011
Other Non Military-Variables	WDI (World Development Index) of World Bank	2010

Abstract

Mainstream economic theory predicts that military conscription is associated with static inefficiencies and dynamic distortions of the accumulations of human and physical capital, relative to an all-volunteer force recruitment system.

To examine the effect of conscription on economic performance, panel data from 21 OECD countries is used. Surprisingly, the estimates do not always indicate negative influence of military conscription on economic performance, especially when fixed effects are accounted for.

Kurzfassung

Die klassische ökonomische Theorie besagt, dass im Vergleich zu einer Freiwilligenarmee eine Wehrpflicht sowohl mit statischer Ineffizienz als auch dynamischer Verzerrung der Human-, und Sachkapitalakkumulation assoziiert sei.

Anhand von Paneldaten aus 21-OECD Staaten wird der Einfluss des Wehrdiensts auf die Wirtschaftsleistung geprüft. Überraschenderweise entsprechen die geschätzten Koeffizienten nicht immer dem negativen Einfluss des Wehrdiensts auf die Wirtschaftsleistung, den klassische Theorien prognostizieren, insbesondere dann, wenn Fixed Effects kontrolliert werden.

Curriculum Vitae

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